UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 2
290 Broadway
New York, NY 10007-1866

November 14, 2018

Ms. Rachel Vocaire
The Sherwin-Williams Company
101 Prospect Avenue
4 Midland
Cleveland, OH 44115-1075

RE: EPA Comments on October 4, 2018 Technical Memorandum for the Former Manufacturing Plant (FMP) area

Sherwin-Williams/Hilliards Creek Superfund Site – Operable Unit 2 (Soils)
Administrative Order Index No. II CERCLA-02-99-2035

Dear Ms. Vocaire:

The U.S. Environmental Protection Agency (EPA) has reviewed the October 4, 2018 Technical Memorandum, *"Evaluation of the Applicability of Thermal-Enhanced Recovery at the FMP area*" and is providing the following comments (Enclosure).

EPA looks forward to meeting with Sherwin-Williams on November 19, 2018 to discuss the enclosed comments, which relate to the on-going Operable Unit 2 (OU2) Feasibility Study (FS) activities. If you have any questions, please contact me at 212-637-3916 or at Klimcsak.Raymond@epa.gov.

Sincerely,

Ray Klimcsak, Remedial Project Manager
New Jersey Remediation Branch

Enclosure

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1. EPA concurs with Sherwin-Williams that the most likely area for application of thermal remediation is Area 1 (the former Resin Plant/Tank Farm A area); EPA is recommending that thermal remediation be evaluated further as part of the ongoing Feasibility Study (FS). Because the cost of thermal remediation is directly proportional to the area to be treated, the thermal treatment area should be only where LNAPL exists. This will reduce the estimated area for treatment from the 297,000 ft^2 given for Area 1 in the Tech Memo. According to page 37 of the LNAPL Report, the hydraulic conductivity of the LNAPL-contaminated areas is in the range of 0.2 to 14 feet per day (ft/day), which is marginal for the application of steam enhanced extraction (SEE). However, with a groundwater seepage velocity in the range of 0.01 to 0.08 ft/day, either Electrical Resistance Heating (ERH) or Thermal Conductive Heating (TCH) should be able to heat the site to the boiling point of water. A significant proportion of the LNAPL should be recoverable at this temperature through volatilization, and it is likely that LNAPL could be recovered as a liquid as well (see comments #5 and 10). The most volatile petroleum hydrocarbons are generally the most soluble also, thus the removal of the volatile components of the LNAPL will significantly reduce groundwater concentrations.

2. EPA concurs with Sherwin-Williams that Areas 2 (Seep Area) and 3 (Eastern off-property area) are not suitable for thermal remediation.

3. EPA concurs with Sherwin-Williams that Area 4 (U.S. Avenue and Foster Avenue, Gibbsboro) is not suitable for thermal remediation. However, in some cases ERH has been used underneath roadways and parking lots without damage to the roadway and utilities, and without having to close the area to traffic. Offsets from utilities are generally 5 to 15 feet for TCH and 15 to 20 feet for ERH, depending on the type of utilities and composition of the piping.

   Examples of sites where EPA has utilized thermal remediation in the vicinity of active communities includes: Groveland Wells Superfund Site, Pemaco Superfund Site, Beede Waste Oil Superfund Site and Camelot Cleaners Site.

4. It is stated on Page 3, that "Key physical attributes of the LNAPL that are important to thermal technical evaluations include: Initial Boiling Point: 145 to 175 ºC". However, the LNAPL Report (page 39 and Table 6-1) states that the initial boiling point for LNAPL samples acquired from this site are 240ºF (115ºC) and 275ºF (135ºC) for samples collected from wells MW-11 and H-3P, respectively.

5. It is stated on Pages 3 and 4 - "EPA has commented that in the presence of groundwater, co-boiling would likely occur at lower temperature such as 85 to 95ºC. However, the majority of constituents in mineral spirits (even with co-boiling) will not boil at these lower temperatures, with mass loss occurring through partitioning of mass into vapor due to temperature elevation." Co-boiling occurs when there are two separate liquid phases present, each contributing significantly to the vapor phase. Boiling occurs when the total vapor pressure of the two liquid equals the local pressure, which for an LNAPL located in the unsaturated zone would be atmospheric pressure. Considering the initial boiling points of the LNAPL here (see comment #4), co-boiling of these LNAPLs in the presence of groundwater would be expected to occur at approximately 87ºC and 92ºC, respectively. Compounds that have boiling points greater than approximately 220ºC would not be expected to produce sufficient vapors at temperatures below 100ºC to significantly lower the boiling point of water. Thus, aliphatic compounds with normal chain lengths up to 12 carbon atoms would be expected to be recovered by this mechanism at the boiling point of water, as

well as the lower boiling point compounds, which includes benzene, toluene, ethylbenzene, and xylenes (BTEX), and cyclohexane and methylcyclohexane, which comprise a significant fraction of the LNAPL samples.

6. It is stated on Page 4 that, "thermal remediation activities will result in sterilization of the soil (and associated bacteria consortia) which will significantly stunt natural attenuation processes". Similar concerns of sterilization of microbial populations and impeding future biological degradation rates are expressed on pages 9 and 12. This has not been found to be true at sites where thermal remediation has been completed. For example, at the Solvents Recovery Services New England (SRSNE) Superfund site where TCH was used (pictured in the upper left hand corner on page 9 of the Tech Memo), dechlorination was found to continue at a rapid pace after thermal treatment. At the former Williams Air Force Base Superfund Site, although some types of bacteria appeared to be less abundant after SEE, methanogenesis appears to still be occurring at an appreciable rate.

7. It is stated on Page 4 that, "The impacts are contained within an unconfined groundwater system and, as such, any steam production associated with thermal remediation activities will occur at near atmospheric pressure". Similarly, page 7 of the Tech Memo it is stated that, "Since there is no confining unit that would create subsurface pressures greater than atmospheric pressure, the boiling points will be consistent with those observed under atmospheric conditions." However, the boiling point of water – as well as the co-boiling point of a compound in the presence of water – will increase below the water table due to the hydrostatic pressure exerted by the groundwater. For every 10 feet below the water table, the boiling point will increase by approximately 6^{o}C.

8. It is stated on Pages 4 and 5 that, "Imbibition testing . . . found that even under high pressures, no LNAPL was displaced from the soil pore matrix. These findings supported a conclusion that the LNAPL in the majority of the area is neither recoverable nor mobile." This statement is inconsistent with the significant volume of LNAPL that has been recovered from the Seep area and the presence of LNAPL in other wells around the site. Specifically, although soil samples from DP-26 did not indicate saturations sufficient for the LNAPL to be mobile, MW-11, which is adjacent to the boring, contained LNAPL. Also, although DP-18 did not indicate the presence of mobile LNAPL, approximately 90 gallons of LNAPL were recovered from this area in 2017 (Table 7-1 of the LNAPL Report).

9. It is stated on Page 6 that, "Enough energy (usually electricity) must be available directly at the site. If sufficient electricity is not available from the local electric utility, then electric generators are used to supply the electrical deficit." Similarly, page 12 states, "High electrical demand could impact on local users". It is true that the electrical requirements are significant for large sites, and the thermal vendors work with the local electrical companies to supply the power. When an adequate supply cannot be reasonably supplied, a phased approach has been taken. The total area to be treated can be broken into smaller areas that can be accommodated by the power available, and when one area is completed, operations can be initiated at another area. This approach works because the time to treat an area is generally short, on the order of six months to

a year, allowing the overall project to still be completed in a reasonable time. The power usage of the site will not interfere with the power supply to other local users.

10. It is stated on Page 7 that, "a technology that can maintain temperatures above 100^{o}C is needed to achieve LNAPL mass removal". This is not necessarily true for LNAPL mass removal. Through co-boiling (see comment #5), raising of vapor pressures, and increases in the Henry's Constant of the contaminants present, the majority of the LNAPL mass can be recovered in the vapor phase even without reaching or coming close the to boiling point of a compound. Also, LNAPL trapped below the water table can adhere to bubbles generated below the water table (for example, degassing of carbon dioxide) during heating, which will raise the liquid to the water table. The LNAPL can coalesce at the water table to form a mobile liquid that allows it to be collected as a liquid, and will aid in recovery of the higher boiling compounds that are not readily volatilized. This process was observed at a site where ERH was used to recover diesel fuel.

11. It is stated on Page 8 that, "there are proximal sensitive receptors residents to the south-east and a police station to the south-west of the treatment area". Similarly, page 9 states, "Residential areas adjacent to the thermal treatment area may be affected by vapor and steam migration". Thermal remediation systems are operated under vacuum, so that the vapors and steam generated are collected for treatment. Steam in the subsurface cannot travel significant distances from the heated area; when it encounters cooler soils it will condense. The above ground treatment systems are also generally under vacuum, so that if a leak were to occur in the system, air would be pulled into the treatment system rather than vapors escaping the system. When receptors are nearby, continuous photoionization detector (PID) readings are generally made at the perimeter of the treatment area to ensure detection of the air born vapors should they occur so that corrections to the system can be made. Thus, fugitive emissions should not affect nearby receptors. At the SRSNE site, there is a police station directly across the street from the site. Construction and operation of the large thermal treatment system did not interfere with the operations of the police station.

12. It is stated on Page 9 that, "Above ground buildings over the target treatment zone would require removal." This statement is not accurate. Electrodes or heater wells have been inserted vertically through the floor of buildings, at angles under the building, or horizontally under building to successfully heat and recover contaminants from under the building. A recent example of this is the South Municipal Well Superfund site where angled electrodes and extraction wells were installed under an active manufacturing facility to successfully recover a source zone from under the building. In addition, based on information provided by EPA Region 2, the 2 and 4 Foster Avenue structures are not currently occupied and due to relatively high ceiling clearances, the structures are likely able to accommodate a drill rig in the interior. This would allow installation of vertical heater wells or electrodes through the floors of the buildings.

13. It is stated on Page 9 that, "The high temperatures needed to remove the LNAPL could deform or damage roadways or lose structural integrity when heat is applied to the subsurface." Since underground utilities are located along the roadways, it is anticipated that there will be an offset of 5 to 20 feet of the treatment area from the roads. Based on experience at other sites and heat

conduction in soil principles, the roads should not increase in temperature more than about 30ºC during thermal remediation.

14. It is stated on Page 9 that, "Silver Lake, a major recharge feature, would cause steeper gradients and facilitate an influx of cold water into the treatment areas, limiting treatment efficiency." Large influxes of water limit the ability of TCH or ERH to heat the subsurface to the temperatures desired for thermal treatment. Based on the current groundwater seepage velocities (see comment #1), the groundwater seepage rate would have to increase by more than an order of magnitude to challenge these technologies. Based on the relatively low reductions in groundwater elevation that would be expected, I do not believe that the proposed treatment area would be sufficiently dewatered to create the necessary gradient to increase the inflow rate to that extent. If additional investigation of the hydraulic conductivity of this area were to show that significant inflow would be expected during thermal remediation, then Steam Enhanced Extraction (SEE) should be the chosen thermal remedy for this site. The injection of steam under pressure with this technology will reduce the inflow of groundwater to allow the site to be heated.

15. Page 11 raises the concern of Thermal desiccation of soil during thermal treatment and the potential for settlement. While desiccation of the soil can occur during thermal remediation, experience at other thermal remediation sites has shown that settlement is a concern only with 'fat clays' and soils comprised of peat.

16. Page 12 raised the concern of nuisance associated with heating of water pipes, and suggests that water supplies may boil in pipes adjacent to the thermal treatment area. Even if the water pipe runs through a thermal treatment area, noticeable increases in the temperature of the water are not likely. The operation of thermal systems is such that it normally takes 60 to 90 days for the soils to reach 100ºC. As long as water is continuing to flow through the pipes, it cannot absorb enough heat while in the treatment area to cause a significant temperature increase.

17. It is stated on Page 13 that, "Thermal treatment will result in the discharge of heated groundwater into Hilliards Creek, with potential impacts on aquatic receptors." It appears that Hilliards Creek is more than 200 feet from the proposed treatment area, and Figure 5-11 of the LNAPL Report indicates that the direction of flow from the proposed treatment area should be more parallel to the Creek than into it. Further, while not depicted in the figure on Page 8, it is important to note that an upstream portion of Hilliards Creek is channeled within a concrete culvert. However, if further investigation were to find that groundwater from the treatment area would recharge the Creek in significant quantities, then engineering controls, such as groundwater extraction wells between the treatment area and the Creek, could be used to protect the Creek.

18. It is stated on Page 13 that, "Long-Term Effectiveness and Permanence: Thermal treatment and the combined remedy would rank similarly for this criterion. Both technologies would remove LNAPL from Area 1. However, residual LNAPL would remain after application of thermal treatment and would need to be addressed via bioremediation." The major difference is the time that would be required to reach remedial goals. Thermal remediation is typically completed in

less than a year, although large sites may require somewhat longer times. Bioremediation, even with the passive recovery of mobile LNAPL, will take many more years, and it is difficult to estimate the time frame that will be required.

19. It is stated on Page 13 that, "Short-Term Effectiveness: Thermal treatment would rank very low as a result of the very significant impacts on the nearby residential area, subsurface utilities, adjacent roadways, Hilliards Creek and buildings in the treatment area." Please see comments #3, 11, 12, 16 and 17. It appears that the residential areas are separated from the proposed treatment area by a major roadway (United States Avenue), which means that traffic to the site will not pass through the community. This will reduce impacts to the community.

20. It is stated on Page 13 that, "Reduction in Toxicity, Mobility or Volume Through Treatment: Although thermal treatment would reduce the volume of LNAPL within the actual treatment area, it would negatively affect the ongoing biodegradation within and around the treatment area. Therefore, it would rank low for this criterion." See Comment #6.

21. It is stated on Page 13 that, "Implementability: Thermal treatment would rank very low for this criterion as a result of the presence of buildings that would need to be removed, the large scale of the project, and the need for the very large infrastructure needed to supply electricity, heat the subsurface and manage the produced steam, vapors and LNAPL." Please see comment #12. The thermal vendors have the capability to treat large sites. The largest site that has been treated to date was approximately 400,000 cubic yards at the former Williams Air Force Base.

22. It is stated on Page 14 that, "Given the significant impacts on the community, it can be predicted that, if thermal treatment was included in a Proposed Plan, it would not be acceptable to the community." Similarly, page 9 states that construction of a thermal project on this scale would be a substantial nuisance to the residents, and page 11 states that traffic and noise impacts on the community during construction, and visual impacts on the community during operations. Other communities have been receptive to thermal remediation over other technologies due to the much shorter remedial times that are required.

23. Comment on the LNAPL Report - The Physical Properties Data – Pore Fluid Saturations data from Appendix C lists total porosities as high as 50.2 percent, with many porosities greater than 45 percent. These are somewhat high for subsurface soils consisting of sands and silts. The effect of porosity values being high is that it would tend then to decrease the NAPL percent saturation values, and possibly make mobile NAPL appear to be immobile.